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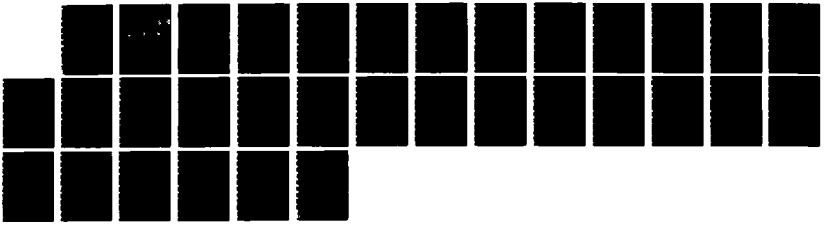

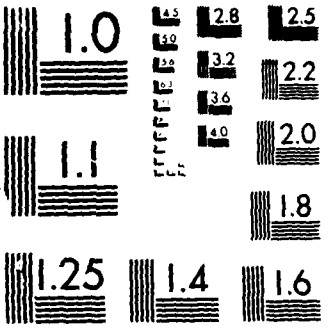

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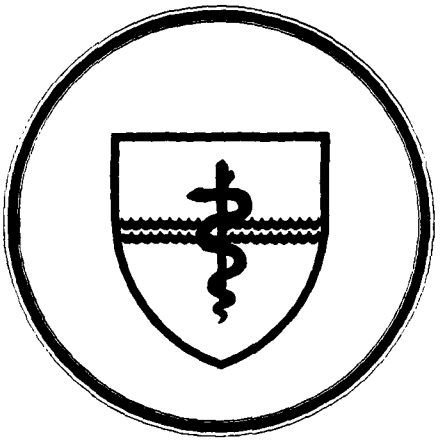

REPORT NUMBER 1077

LONGITUDINAL ANALYSES OF INVOLUNTARY TURNOVER CHARACTERISTICS WITHIN THE SUBMARINE SERVICE:

Non-Nuclear Trained Enlisted Personnel

by

Kendall J. Bryant

Naval Medical Research and Development Command
Research Work Unit M0096.001-1052

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Released by:

C. A. Harvey, CAPT, MC, USN
Commanding Officer
Naval Submarine Medical Research Laboratory

19 June 1986

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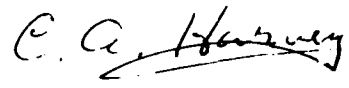

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SUMMARY PAGE

THE PROBLEM

Identify rate and type of attrition in non-nuclear power trained enlisted personnel over the term of their enlistment.

THE FINDINGS

An overall projected rate of attrition was 48% in 14 quarters of service. Three periods of losses were identified using rational and empirical clustering methods. Early losses related to problems in submarine school, middle losses related to behavioral and psychological problems during deployment, and later losses at about 3 years were related to misconduct behavior. Loss characteristics were discussed in relationship to other areas of organizational research.

APPLICATIONS

The analyses provide a basis for the design of an effective psychological screening program. In addition, the research outlines other areas of investigation relevant to employee job withdrawal behavior.

ADMINISTRATIVE INFORMATION

This investigation was conducted as part of Naval Medical Research and Development Command Work Unit M0096.001-1052 - "Reduction of attrition rates for submarine personnel through improved psychiatric screening and selection procedures." It was submitted for review on **7 March 1986**, approved for publication on **19 June 1986**, and has been designated as Naval Submarine Medical Research Laboratory Report No. **107**.

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ABSTRACT

Previous studies that have examined personnel losses from the submarine service have not described the overall patterns of attrition. Recently, a method for tracking career outcomes for submarine service personnel has been instituted. This paper presents the preliminary analysis of loss characteristics for personnel within the submarine service. A sample of 3607 submariners who entered Basic Enlisted Submarine School (BESS) in FY80-81 was tracked for up to 14 quarters using the Enlisted Survival Tracking File (STF).

This research was undertaken to understand more about each of the various groupings of individuals lost from the submarine service. The temporal distribution of losses may illuminate psychological and historical characteristics of submarine service personnel operations. Initial analyses classify individuals completing or failing to complete their tour of duty as indicated by Department of Defense loss codes. Later analyses rationally classify losses into broad groups of misconduct, psychological, physical, and performance loss categories.

Finally, groups identified by Department of Defense loss codes were empirically clustered on the basis of time to important career events (entry into submarine school, completion of submarine school, assignment to submarine, and qualification) and percent loss for each group at each career transition (graduation, submarine assignment, and qualification).

Three distinct loss periods are present in the sample examined. The first period (within one year after entry into the submarine service) reflects academic difficulties. The second period (the first to second year) represents behavioral difficulties during adaptation to the submarine environment. Finally, the third period of loss, and the most pronounced (approximately the third year), is characterized by misconduct offenses.

Several possible explanations for the loss characteristics are presented. In general, individuals likely to be successful in completing their term of enlistment have been delayed in their assignment to active submarine duty. This delay is most likely due to additional specialized training. Three avenues of investigation relating to voluntary turnover in other employee environments are discussed (Organizational Committment, Job Attachment, and Stress Responses). These constructs are related to specific areas for future research on involuntary attrition from the submarine service. It is suggested that a model for withdrawal from the submarine service be developed and psychological screening programs for identification of individuals likely to be lost prematurely from the submarine service be instituted.

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LONGITUDINAL ANALYSES OF INVOLUNTARY TURNOVER CHARACTERISTICS WITHIN THE SUBMARINE SERVICE

NON-NUCLEAR TRAINED PERSONNEL

In the past, attrition from the submarine service has been investigated through the analysis of the incidences of psychiatric referral and diagnoses, self-reports of causes for de-volunteering, and classification codes used at the time of the loss from active service. In addition, epidemiological research has provided a more general description of psychological characteristics for the active duty submarine population.

The analysis of clinical referrals of personnel assigned to operational units has yielded formal classification into psychiatric diagnostic categories (Satloff, 1967). These classifications were made by a single judge or after a case conference. Subsequently, these diagnoses were used in formulation of recommendations and decisions regarding retention of the individual for active submarine service. Satloff (1967) used the major diagnostic categories as understood at the time (Psychotic, Neurotic, Personality Disorder, etc.). Overall, approximately eight major categories and thirty minor categories were used.

An overall referral rate of 3.8% was found in 2634 officers and enlisted men during a one year period. The population under study were all officers and enlisted personnel assigned to an operational submarine during a one year period. The personnel evaluated were primarily on active duty assigned to the operation or maintenance of submarines and had had extensive submarine experience. Half of those evaluated were lost from the submarine service. The largest category in use was Personality Disorder accounting for approximately 40% of the referrals and discharges, more than any other diagnostic category. Satloff concludes that "... this kind of duty induces a low-level but constant environmental stress that in time can lead to the deterioration of many initially compensated individuals."

In an epidemiological study Weybrew and Noddin (1979) used scales from the Minnesota Multiphasic Personality Inventory (MMPI) for classifying a sample of submariners who participated in a longitudinal health study. Their sample consisted of 1013 submariners (143 officers and 870 enlisted men) with a mean of nine years of active duty service. The investigators noted that within the enlisted sample a standard score of 70 or higher was assigned to 15% on the Depression Scale (D), 14% on the Psychopathic Deviate Scale (Pd), and 17% on the Hypomania Scale (Ma). In addition, approximately 10% of the enlisted sample had a standard score of 70 or greater on Masculinity-Feminity (Mf), Psychoasthenia (Pt), and Schizophrenia (Sc). Less than 5% of a normal population should achieve a score of 70 or greater. On all clinical scales, enlisted personnel had a higher percentage of deviate scores than officers. This study suggests that the range of incipient psychological problems is greater than the 3.8% referral rate observed by Satloff (1967).

Weybrew and Noddin (1979) also identified two- and three-scale profiles indicative of different psychological disorders. These results are only suggestive of the nature of these disorders; they represent idealized types and general parameters for the base rates for these "types." The three trait clusters were labelled Emotional Stability, Character Attributes, and Reality Appraisal.

Emotional Stability was related to elevations on the D and Pt scales. Approximately 10% of the enlisted sample exhibited this 2-7 MMPI profile. These individuals are described as having high standards of performance and being chronically anxious in their attempts to achieve. They tend to respond poorly to the accumulated effects of stressful events by becoming depressed and feeling overwhelmed.

The Character Attributes cluster was related to elevations on the Pd and Ma scales. Enlisted personnel with elevations in excess of a standard score of 70 on both of the scales accounted for 5.4% of the sample. The 4-9 profile corresponds most directly to the diagnostic category of sociopathic personality or antisocial reaction. Individuals diagnosed as having an antisocial personality are described as lacking in emotional maturity, failing to take responsibility for their actions, and behaving impulsively.

Research on military populations has related this character type to a failure in reliable performance under stressful conditions (Weybrew & Noddin, 1973a, 1973b). Similar scales, such as the Socialization Scale of the California Psychological Inventory (Gough, 1948; Gough & Peterson, 1952), have been validated on military populations (Datel, 1962; Knapp, 1963, 1964).

Finally, Reality Appraisal was operationally defined as elevation above a standard score of 70 on the Sc and Ma scales. This cluster most directly relates to schizo-affective disorders and is only represented in a small proportion of the submarine population (approximately 2.1%). While the prior two trait clusters may represent personality disorders and not be identified easily in individuals, the schizo-affective disorder is strongly manifested in everyday activities. It is most likely that these individuals would be referred for psychological evaluation.

While the previous discussion has concerned psychological classification of individuals on the basis of MMPI scale profiles, it does not directly reflect the self-perceptions of those individuals. Self-reports present a different viewpoint; individuals evaluate the reasons for their own actions. Individuals have been retrospectively classified on the basis of their self-reports for devolunteering from the submarine service. Noddin (1972) identified thirteen classes of motives: Motivational deficiencies, Habitability, Workload, Maladjustive Symptoms, Attitudes toward the Nuclear Power Program, Non-submarine interest, Family problems, Deployment, Status Incongruence, Interpersonal Problems, Pacifist Attitudes, and Other.

He concluded that lower paygrade men

were more likely to devolunteer due to the perceived dangers of the submarine environment. In contrast to this group, higher paygrade men, those who were at that time most often associated with the nuclear submarines, pointed not to the perceived dangers, but to family problems as a major source of dissatisfaction. There seems, then, to be an interaction between status (as measured by paygrade) and the perception of the hazardousness of the submarine environment.

A procedural method for classifying losses from the armed service is used by the Department of Defense to describe the nature of each individual loss. This provides the major comprehensive source of information on losses from the submarine service. Over 50 major and minor codes are in use to describe these losses. These codes are primarily procedural in that certain classes of codes are the result of actions within the military system. These codes provide a functional taxonomy of outcomes within the system. In short, they provide the most direct indication of the overall functioning of the system.

While the use of the MMPI or Department of Defense classification codes represent different methods of classification and perform different functions within the context of their use, it is necessary to integrate them conceptually to provide an effective understanding of outcomes within the submarine community. In a broad sense, these methods of classification represent psychological and procedural (administrative) information about individuals' career outcomes. Outcomes are the end result of both the individual's interaction with the physical environment of the submarine, social environment of the submarine community, and the military system's provision of a circumscribed set of ways in which an individual may leave the submarine service. The classification categories for losses may, themselves, provide clues as to the causal or antecedent conditions necessary for disqualification from the submarine service.

Longitudinal analysis of loss characteristics describes the temporal profile of losses within a defined group. Proportions of losses may be estimated relative to an initial event such as entry into submarine school. It may also be used diagnostically to identify high loss periods and indicate those events that precipitate losses. Complex loss curves in which multiple distinct periods of losses are present or the rate of loss accelerates or decelerates over time may indicate that multiple causes may be identified for the losses. When designing intervention programs for reduction of attrition, these types of analyses may help to indicate at what point the intervention may be most effective.

Organization of Analyses

The paper is organized into three parts: a) General loss characteristics; b) rational clustering of loss groupings; and c) empirical clustering of loss types.

Method

Subjects: Subjects were 3607 enlisted personnel who entered classes in Basic Enlisted Submarine School (BESS) in FY80 and FY81. No nuclear power

trained personnel are included in the present sample. Enlistees must volunteer for the submarine service to be considered for submarine school and must have successfully completed basic training. Approximately 85% enter as either recruit, apprentice, or seaman. The remainder of the group is composed primarily of 3rd class petty officers. Most of the sample (75%) are between the ages of 18 and 20 years of age and have completed at least high school educations (83%).

Enlisted Survival Tracking File (STF):

The STF was developed for longitudinal analysis of Navy personnel information. The data base contains the chronological record of individuals' career activities within the Navy. The longitudinal aspect of the STF (STF-L) contains quarterly updates for each individual. Collation of data for the STF began in FY 1977.

Method of Analysis: The use of survival analysis is superior to the reporting of simple loss percentages because it describes the time to the loss and takes into account individuals with incomplete records or those who may have been lost from the study for extraneous reasons. An extensive literature exists on the computation of parametric and non-parametric survival functions and related measures (Gross & Clark, 1975; Kalbfleisch & Prentice, 1980; Lee, 1980).

Description of Career Events: The submarine service has a highly structured and demanding program for selection and training of their enlisted personnel. Initially, individuals must volunteer for the submarine service at the time of recruitment or after basic training. Following recruitment to the submarine service, personnel enter Basic Enlisted Submarine School for a period of six weeks. Difficulties relating primarily to academic performance in submarine school result in dispersion of a cohort into later classes (setbacks). Subjects are routinely screened for psychological adjustment and physical fitness at the outset of submarine school. Between 10 to 15 percent of individuals who enter submarine school do not graduate. The majority of these losses are classified by BESS staff as motivational drops. These individuals usually are assigned to the surface fleet for duty, or, in some cases, are discharged for medical or administrative reasons.

Next, graduates are either assigned to a submarine or to another school for additional training in a specialty area. The latter course of action delays submarine assignment. Once assigned to a submarine, individuals must qualify at all of the various on-board duty stations except nuclear power plant operation. Qualification usually takes place at sea during deployment. Individuals are encouraged to qualify as quickly as possible. Failure to qualify within a reasonable period leads to dismissal. Four measures may be computed to reflect important career events. Time is computed in quarterly (3 month) periods.

Time to Entry: The time between the first record appearing for a subject and the record in which the submarine school unit identification code was assigned. This measure reflects prior military experience.

Table 1: Losses[a] from Active Submarine Service for FY80-81 Sample

	Lost from Submarine Service	Remaining in Submarine Service as of 1984
FY80	38.7% (465)	61.3% (738)
FY81	30.5% (733)	69.5% (1671)
FY80 + 81	32.6% (1203)	67.4% (2404)

[a] Losses do not include submariners completing their tour of duty.

Time to Graduation: The time between the first record indication that the subject was enrolled in submarine school and the date recorded for graduation from submarine school was assigned. In the case of academic difficulties, this interval also reflects setbacks.

Time to Submarine: The time between the first record indicating that the subject was enrolled in submarine school and the record indicating an active submarine unit identification code was assigned.

Time to Qualification: The time between the first record indicating that the subject was enrolled in submarine school and the record indicating qualification aboard submarines was calculated. In addition, the time between completion of submarine school and qualification was also computed although this information was not uniformly available within the records.

Results

General Loss Rates: Table 1 presents the losses for FY80-81 BESS students. Individuals who completed their obligated duty within this time period are excluded from these initial analyses. In the FY80 sample, all subjects began in the 4th quarter. In the FY81 sample, all subjects began in the 1st and 2nd quarters. The longest that any subject could have been in the present sample when the outcome data were obtained was 14 quarters.

In the FY80 sample, 38.7% of the group had been lost by FY84. In contrast, 30.5% of the FY81 group had been lost by this same point. The overall loss rate to this point was 32.6%. Almost identical loss rates (33%) are reported by Sands (1978) for a general Navy population of new male enlistees (n = 68,616).

A test of equal proportionality for FY80 vs FY81 sample was significant for the 8.2% increase in losses in these two groups (Chi Square = 17.96, df = 1, $p < .001$). The FY80 sample had from 1 to nearly 3 quarters additional service, and hence were exposed to the risk of becoming lost for a longer period of time. When comparable random samples were drawn from the two years and matched on the basis of length of their expected service, no significant difference was found relating to the year of entry. Similar patterns of attrition are present for both years.

Table 2 presents the number lost after each career event and the mean elapsed time between entry to BESS and career milestones in quarters for those lost and continuing. Individuals who were lost entered submarine school with less experience than those continuing, graduated more quickly, and were almost immediately assigned to a submarine. Few of the loss group were qualified at the time of loss. The mean loss time was 7.55 quarters for those who were in the loss group. In contrast, those continuing had, on the average, completed 11.9 quarters of service. Most had qualified by this time.

In addition, time intervals were computed between time of graduation and time to assignment to submarine, and between time of graduation and time to qualification. Those individuals

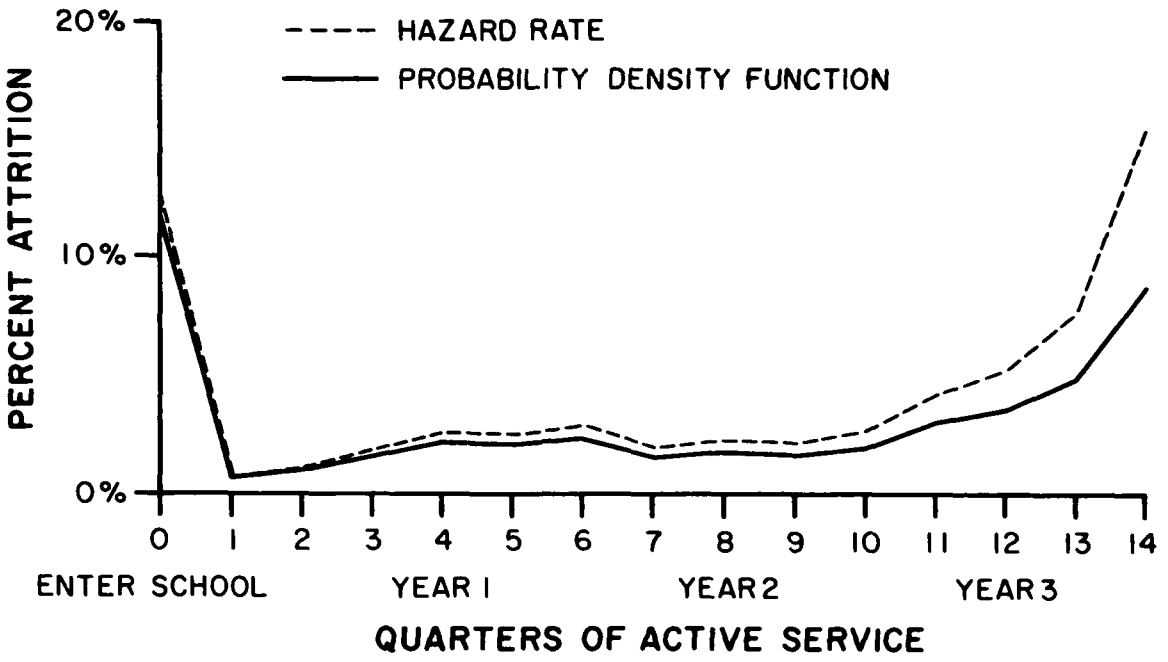
Table 2: Time from Entry into Submarine School to Career Milestones

Group	Time to Entry	Time to Graduation	Time to Submarine	Time to Qualification	Time to Loss
Lost from Active Service	1.13 (1196)	1.25 (762)	1.56 (707)	6.69 (213)	7.55 (1203)
Continuing	1.26 (2486)	1.69 (2435)	2.99 (2223)	8.86 (1587)	11.9 (2404)

Time from Graduation from Submarine School to Submarine or Qualification

Group	Time to Submarine	Time to Qualification
Lost from Active Service	.94 (682)	4.81 (194)
Continuing	2.26 (1962)	5.23 (1485)

Figure 1: Submarine Service Enlisted Attrition: FY80-81 Sample



within the loss group were very quickly assigned to submarines approximately one quarter after graduation. However, they took an additional four quarters to become qualified (of the few that did). In contrast, those submariners remaining in the submarine service took more than two quarters to be assigned to a submarine and the majority had qualified within three quarters from this point.

Clearly, those individuals sent to submarines more quickly are at a higher risk of being lost. These individuals may be non-rated personnel who have not qualified for additional schooling. Further investigation is needed to identify the characteristics of these individuals.

Table 3 presents the survival characteristics for the proportion of individuals lost in each interval who enter that interval and the cumulative proportion of the total sample who would be projected to continue through each interval. The hazard rate (approximately equal to the proportion terminating in the interval - see Appendix A for computation) and the probability density function are illustrated in Figure 1. At the projected rates of loss, the cumulative proportion surviving at the end of 14 quarters will be 52.2 percent (47.8% are lost). A loss of between 40 to 50% of the initial population should be carefully evaluated. It must also be kept in mind that the complete enlistment period of 16 quarters is not covered in the present analysis and that the loss rate increases at the end of the enlistment term.

Table 3: Survival Characteristics after Entry into Submarine School

Interval in Quarters	Proportion Terminating in Interval	Cumulative Proportion Surviving
0.0[a]	11.5	88.5
1.0	.7	87.9
2.0	1.0	87.0
3.0	1.8	85.4
4.0	2.5	83.2
5.0	2.4	81.2
6.0	2.8	78.9
7.0	2.0	77.4
8.0	2.3	75.4
9.0	2.1	74.1
10.0	2.6	72.1
11.0	4.1	69.2
12.0	5.0	65.7
13.0	7.4	60.9
14.0	14.3	52.2

[a] All submarine school losses were recorded in this interval.

The table of the proportion lost by quarters indicates that the loss rate is highest in the first quarter due to losses from submarine school (all submarine school losses were placed in this quarter) and then remains at a constant low level of approximately 2% until the 10th quarter. The loss rate then rapidly accelerates after this point.

The highest loss rates are reflected in the initial entry process at submarine school and the end of enlistment. The middle period in which submariners must become qualified and adjust to submarine life does not show a high attrition rate. Experienced submariners, when asked about this middle qualification period, have described this period as the most stressful, demanding portion of submarine training. However, this increased "stress" is not directly reflected in any specific time period. A small non-significant rise in loss rate is found in the proportion lost from the 4th to 6th quarter. Perhaps the constant rate of losses during the qualification period is a result of a wider range of times in which submariners may qualify ($X = 8.60$, $SD = 3.21$). Perhaps the later rise in disqualification rate after 10 quarters reflects an administrative delay in acting on individuals who do not adjust to the submarine environment and fail to qualify.

Why attrition should increase after 10 quarters is unknown. At this point, most of the individuals lost have qualified for submarine duty. Most of the submarine candidates are now 22-23 years old and unmarried. They have been promoted in their career and may be thinking about developing a career within the submarine service. Further analysis of the types of disqualifications is necessary to understand this phenomenon.

Incidence of Losses by Classification Category

Persons lost to the submarine service were grouped by the substantive descriptor of the Department of Defense classification codes. Losses from submarine school have been excluded from the present analyses. The groups were comprised of persons lost by reason of Performance Failure, Drug or Alcohol Related Misconduct, Misconduct, Physical Disability, Mental Disability, Homosexuality, and Completion of Training. These groups do not represent all remaining losses, but rather the persons who could be assigned to the most clearcut groupings possible.

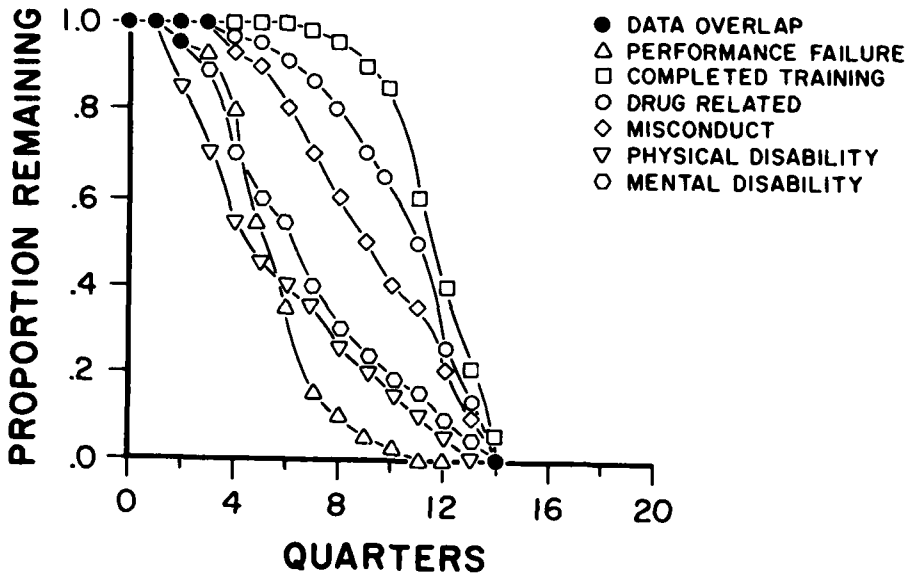
The three largest groups to be lost were Misconduct (259), Performance Failure (142), and Drug-Related (124). The remaining groups numbered approximately 50-80 individuals each. Table 4 presents the cumulative proporation surviving by quarter for each of the rationally clustered groups. The shortest median survival time was for individuals with physical disabilities (4.6 quarters). Next were Homosexual activity (5.0), Performance Failure (5.3), Mental Disability (6.3), Misconduct (9.0), Drug or Alcohol-Related (10.9), and Early Completion of Duty (11.5).

An examination of Figure 2 showing the survival characteristics for the groups indicates that Performance Failure is the most

Table 4: Cumulative Proportion Surviving for Rationally Clustered Groupings

Quarter	Physical Disability	Performance Failure	Mental Disability	Misconduct Behavior	Misconduct Drug	Early Completion
0	97.5	99.3	98.2	100	100	100
1	84.0	96.5	94.6	100	100	98.3
2	69.1	90.1	89.1	99.2	100	98.3
3	56.8	82.4	70.9	95.0	96.8	98.3
4	45.7	56.3	61.8	89.2	93.6	98.3
5	40.7	33.8	54.6	79.5	91.1	98.3
6	33.3	13.4	40.0	68.7	88.7	93.2
7	27.2	10.6	31.9	59.9	80.7	93.2
8	21.1	7.0	21.8	50.2	70.2	88.1
9	14.8	3.5	16.4	40.9	65.3	86.4
10	8.6	1.4	12.7	33.2	47.6	59.3
11	3.7	0.7	5.5	18.9	26.6	39.0
12	2.5	0.0	3.6	8.9	10.5	20.0
13	0.0	0.0	1.8	2.3	1.6	3.3
Median Survival Time (in quarters)	4.6	5.3	6.3	9.0	10.9	11.5
N	81	142	55	259	124	59

Figure 2: Survival Characteristic Curves for Rationally Formed Groupings



clearly defined early loss. Physical Disability, Mental Disability, and Homosexuality are reasons for early loss, but do not show the substantial early incidence of loss that Performance Failure does, after 4 quarters. These loss categories (Physical Disability, Mental Disability, and Homosexuality) show a more gradual decline. Drug-related and Misconduct-related losses are not detected until quite late in the submariners' enlistment and account for most of the later losses described in the previous section. Finally, losses resulting from Early Completion of Duty are shown to permit comparison to other loss categories. Losses from this category are very distinct, and occur after 12 quarters of active duty.

Empirical Clustering of Losses

Department of Defense loss codes were empirically clustered on the basis of time to reach significant milestones. The milestones were: entry into submarine school; completion of submarine school; assignment to a submarine; qualification; and loss. These variables were differentially weighted with respect to percent graduating, percent assigned to submarine, and percent qualified in submarines within each grouping to control for shrinkage in the sample size. Loss codes were selected that had a membership of 15 individuals or more. The group selected for analysis consisted of 18 different classification categories (689 individuals). A stepwise centroid method was used for amalgamating cases on the basis of weighted Euclidean distance.

Table 5: Centroid Clustering of Standardized Times to Key Career Events for Department of Defense Loss Code Classifications[a]

		TIME TO ENTRY	TIME TO SUBMARINE SCHOOL	TIME TO SUBMARINE	TIME TO QUALIFICATION	TIME TO LOSS
CLUSTER 1						
PERSONALITY DISORDER	JHJ	-.44	-.78	.17	-.75	-.63
UNSATISFACTORY PERFORMANCE	JMB	-.19	-.44	.17	-.50	-.93
GOVERNMENT REVIEW ACTION	KND	-.40	-.10	-.10	-1.28	-.81
PHYSICAL DISABILITY	KFN	-.51	-.79	-.36	.28	-1.02
HOMOSEXUAL BEHAVIOR	HRA	-.28	-.45	-.37	-1.28	-.84
CLUSTER 2						
MISCONDUCT (MAJOR)	KFS	-.55	-.44	.54	1.44	.14
MISCONDUCT (MINOR)	HKA	-.51	.24	.01	.82	.20
EARLY SEPARATION	KDM	-.32	-.45	1.77	.40	-.15
MISCONDUCT (DRUG)	HKK	-.34	-.45	1.32	.71	.74
HOMOSEXUAL STATED	HRB	-.20	.23	.88	.28	.02
CLUSTER 3						
REQUIRED SERVICE ENDED	MBK	.202	-.45	-1.26	.71	.86
REQUIRED SERVICE ENDED	MBM	.19	-.45	-.54	1.46	1.45
RELEASE FROM ACTIVE DUTY	LBK	.39	1.23	-.61	.90	1.27

[a] Additional groups were entered into the cluster analysis but did not fall into any clearly defined cluster.

Table 5 presents the standardized coefficients for each of these variables for each group of Department of Defense codes that formed distinct clusters. Three distinct groups emerged. Table 6 presents the mean time to entry, graduation, submarine, qualification, and loss for each type.

The cluster of loss codes that forms Type 1 consists of personality difficulties, physical difficulties, homosexual behavior, and unsatisfactory performance and government review action. Persons found in the Type 1 cluster enter the submarine force, graduate, and are assigned to a submarine within the first six months of their Naval career. However, few of these individuals qualify, with most being lost by their sixth quarter in the Navy. It seems that this group represents behavioral problems that are identified within the first year following graduation from submarine school.

The cluster that forms Type 2 consists of misconduct offenses, early separations in lieu of further actions, drug use, and stated homosexuality. The career of a Type 2 parallels that for a Type 1 until BESS graduation, but is delayed in time to entry onto submarines more so than any of the other groups that are lost. Approximately 25% of these individuals qualify, and they qualify sooner than those continuing. This group represents individuals who engage in behaviors that they should know will lead to separation from the submarine service.

The cluster that forms Type 3 consists of individuals completing their required service and ones released from active duty for extenuating circumstances. Type 3 has substantial prior experience in the Navy before entering the submarine force, graduates at approximately the same rate as those continuing, goes very quickly to submarines, and usually becomes qualified. This group was included as a comparison with others and seems to represent individuals who have completed submarine service, but do not wish to reenlist.

Figure 3 illustrates the survival characteristic curve for each type. Type 2 has the least distinct curve of the 3 types. This may be related to the multicausal nature of misconduct and drug-type of offenses. In all three types, time to graduation was not a discriminating variable. This result is most likely due to the elimination of individuals at submarine school who would have difficulty graduating within the prescribed time, thus producing a restriction of range for this variable.

Figure 3. Survival Characteristic Curve for Empirically Formed Clusters

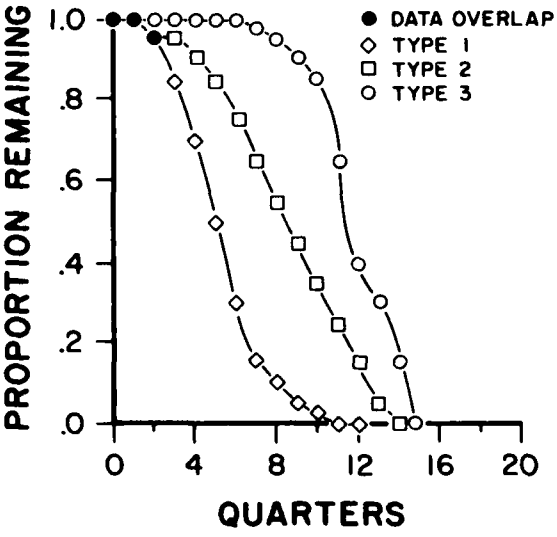


Table 6: Time* to Milestones for Three Empirically Derived Clusters

	TIME TO ENTRY			TIME TO GRADUATION			TIME TO SUBMARINE			TIME TO QUALIFICATION			TIME TO LOSS		
	$\bar{x}$	SD	N	$\bar{x}$	SD	N	$\bar{x}$	SD	N	$\bar{x}$	SD	N	$\bar{x}$	SD	N
Cluster 1	.50	1.31	202	1.06	.58	188	1.29	1.15	185	2.50	2.88	4	4.66	2.13	202
Cluster 2	.54	1.27	351	1.22	.83	212	1.73	1.89	201	6.48	4.41	54	7.86	3.31	351
Cluster 3	1.95	2.76	136	1.40	1.21	130	.88	.87	130	7.26	4.08	73	11.07	2.18	136

* Time in Quarters

General Discussion

Two types of losses have been identified, those that arise from inability to adapt to the submarine environment and later separations that result from misconduct. Two major types of psychopathology have been discussed in the introduction that relate to depression-proneness and misconduct-prone actions. Do these two psychological processes correspond to losses that are observed in the submarine force? For example, does proneness to depression lead to identifiable problems during the deployment period and does poor socialization lead to later misconduct type of offenses?

Mobley, et. al. (1979) have presented a conceptual model of the employee turnover process. While the focus of their review is on voluntary turnover, many of the conceptual dimensions that are proposed are relevant to a consideration of involuntary turnover within the military. The distinction between voluntary and involuntary turnover within the military is often a nebulous one; specific self-elected behaviors (such as drug use) will force a discharge from the military.

Mobley, et. al. emphasize the need to understand the turnover process using the individual as the unit of analysis. Changes in the overall employment situation may produce an increase or decrease in selection ratios; however, a change in these levels does not provide a mechanism for linking individuals' evaluations of their jobs and employee turnover. Thus, in the present study, it is important to consider that while changes in the national employment situation may directly effect selection ratios in the military (e.g., higher overall unemployment may lead to an increased pool of applicants to the military), such overall changes do not illuminate the psychological bases for individual losses.

In addition, Mobley, et. al., point to the need to take into account a wide range of both individual and situational variables. Although constructs such as employee satisfaction have been used to examine psychological aspects of turnover, these variables seem to explain only a small percentage of actual turnovers and the relevance of this variable to completion of military obligated service is not clear. Mobley, et. al. have considered a wide range of variables such as age, tenure, family responsibilities, education, pay, quality of supervision, peer group relations, and other job content factors in their review. Each of these variables accounts for a small portion of total job turnover, but none provides an adequate understanding of any individual's job situation.

Perhaps most indicative of the loss of personnel are individuals' attitudes toward quitting the given job situation (Hendrix, Ovalle, & Troxler, 1985). Gough (1984, 1985) has proposed that specific attitudes toward work may be regarded as dispositional variables with stability over time that can be measured and used to predict job outcome. An attempt to examine such attitudes in

detail has led to an analysis of organizational commitment and job attachment by Porter, et. al., (1974) and Steers (1977). Three components of organizational commitment were identified: a) an acceptance of the organization's goals; b) a willingness to exert considerable effort on behalf of the organization; and c) a desire to maintain organizational membership. Clear parallels for these attitudes exist in the military.

In addition, Koch and Steers (1978) have identified three aspects of job attachment that may be immediate precursors to employee turnover: a) an increasing disparity between one's real and perceived ideal jobs; b) an identification of one's chosen occupation (refinement of job interests); and c) factors leading to a readiness to seek alternative job employment. These attitude changes may be studied within the context of the submarine force and suggest several lines of possible research.

Finally, a third approach has been taken in relating jobs and life stress to employee turnover (Bhagat, 1983; Beehr, et. al., 1976; Beehr & Newman, 1978; Gupta & Beehr, 1979; Schuler, 1980; Hendrix, Ovalle, & Troxler, 1985). Gupta and Beehr (1979) have demonstrated that both the intention to leave as well as voluntary turnover are related to the poor use of individual's skills. Multiple measurements of job stress obtained through interviews (Role ambiguity, Role overload, Under utilization of skills - self report, and Resource inadequacy) also related to job turnover. Bhagat, et. al. (1985) have shown that more general life stresses within the personal life of the employee are also related to organizational outcomes such as employee turnover. There has been a gradual evolution in the conceptualization of life stress and its relationship to psychological adjustment (Depue & Monroe, 1986). Models of stress-disorder relationships may be useful in the study of adaptation to the submarine environment.

How might this brief review of three areas of investigation on voluntary turnover (Organizational Committment, Job Attachment, and Stress Responses) be related to outcomes in the submarine community? Six preliminary avenues of investigation are suggested for mapping psychological processes onto organizational outcomes:

Organizational Committment:

a) The administrative-elimination model: Historical changes in selection ratios and populations available for enlistment have affected administrative decisions in increasing, or decreasing, requirements regarding psychological fitness for submarine service and have subsequently increased or decreased attrition. These administrative decisions have directly affected retention of individuals as well as indirectly defined a more psychological climate

in which jobs are perceived as scarce or plentiful.

Currently, because of increased administrative attempts to identify alcohol or drug dependent individuals as well as increased scrutiny of security classifications, submariners have reported that they feel that there is a change in the nature of submarine duty that has lead to a decrease in organizational commitment. How this change might be assessed and its relationship to overall changes in attitudes towards submarine duty is unknown.

b) The end-of-cycle model: Individuals who are completing their required service have sometimes developed poor attitudes toward the quality of their work; a phenomenon labelled "short-timer's attitude." This attitude seems to be most closely related to both a willingness to exert effort on behalf of the organization and the desire to maintain group membership. Increases in attrition have been attributed to this shift in attitude.

Job Attachment:

c) Skill acquisition model: With increased experience and expertise in submarine operations come additional responsibilities and privileges. The ability of individuals to react positively to these demands will affect decisions regarding reenlistment and future career decisions. Increases in skill level and its relationship to actual job assignment may increase or decrease the disparity between one's real and ideal job. In a similar manner, an individual may be developing a greater knowledge of accessibility of chosen occupations. Limited access to these occupations within the military may make other non-military jobs more attractive.

d) Adult developmental model: Most of the enlisted personnel who were examined in this study entered active service between the ages of 18 and 19. Increased demands of adulthood (e.g., family life) may be poorly integrated by individuals into their concept of a career in the submarine service. This developmental change may be most closely related to an individual's seeking alternative employment.

Stress Response Models:

e) Environmental stressors: Response to long deployments and stressors found within the submarine environment may lead to psychological deterioration. Stressors may be related to specific aspects of task requirements within specific job designations. Social support within the organizational structure may be able to ameliorate specific environmental stressors.

f) Situation-specific models: Highly stressful situations that occur during overhaul or new construction may lead to high attrition rates. Specific situations may be able to be identified that lead to high attrition rates.

Review of research on losses from the submarine force has left many

unanswered questions. Losses from the submarine force must be studied as a dynamic process through longitudinal designs with repeated measurements. While identification of causes of turnover may be a troublesome issue, it is not an insurmountable one. A number of aggregate measures should be evaluated at the entry of an individual into the submarine force, throughout his tenure, and at the point of loss. Categorizations of reasons for turnover available from military records do not provide adequate information for understanding the causes for losses. Many factors may influence these administrative decisions. Perhaps it would be more fruitful to conceptualize losses from the submarine force as the end point in a continuing process of individual withdrawal that includes changes in attitudes in response to important career events prior to the actual loss.

As an outgrowth of such a model, a screening program should be developed to identify the beginning of this withdrawal process, and the antecedent variables that place individuals at risk for being lost. This program of screening could be an extension of psychological screening programs already in place. In addition to screening submariners for traditional indicators of psychological adjustment, dimensions relating to adaptation to the specialized organizational environment of the submarine service could also be included and validated within the target community.

Such a test has been developed and is being validated. The Health Adjustment Survey (Bryant, 1986; Bryant & Noddin, 1986) combines three perspectives. First, it identifies individuals in distress; second, it identifies modes of adaptation to stressful environments and events; and third, it identifies dimensions of work adjustment and organizational commitment. The need for an integrated approach is evident if we are to better understand the bases for loss of personnel from the submarine force.

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Author Notes

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Appendix A

LIFE TABLE ESTIMATES

n_i = number of submariners who had completed i number of quarters of active service

c_i = number of submariners who had entered this quarter but no additional information was available. It was assumed that these individuals continued in active service who had no loss code reported. (censored data)

The number of submariners that were exposed to the risk of being lost from submarine force during interval i is estimated as:

$$r_i = n_i - 1/2\ c_i$$

where r_i = the number at risk

It is assumed that censored observations occur randomly within the interval and thus are considered at risk for half of the interval.

The conditional probability of being lost during this interval is estimated as:

$$q_i = l_i / r_i \qquad \text{Probability of loss}$$

$$P_i = 1 - q_i \qquad \text{Probability of continuing}$$

where l_i = number lost in the interval

The cumulative survival function is estimated as:

$$P_i = P_{i-2}\ P_{i-1}$$

where $P_i = 1$

This estimate reflects the fact that survival to the i^{th} interval requires that one survive to the $i^{th} - 1$ interval. The standard error is defined as:

$$\text{s.e.}\ (P_i) \tilde{-} P_i \left\{ \sum_{j=1}^{i-1} (q_j / rp_j) \right\}^{1/2}$$

The hazard function is estimated at the midpoint of each interval as:

$$_i = 2q_i / (1+p_i) \qquad \text{with}$$

$$\text{s.e.}\ _i \tilde{-}\ _i \left(1 - (1/2)^2\right)^2 / (r_i q_i)$$

This provides the instantaneous loss rate for each interval.

The loss density function is estimated as:

$$f_i = P_i q_i \quad \text{with}$$

$$\text{s.e.}\ (f_i) = P_i q_i \left(\sum_{j=1}^{i-1} \frac{q_j}{r_j p_j} - \frac{P_i}{r_i} q_i \right)^{1/2}$$

and is an estimate of the probability of loss per unit time.

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Previous studies that have examined personnel losses from the submarine service have not described the overall patterns of attrition. Recently, a method for tracking career outcomes for submarine service personnel has been instituted. This paper presents the preliminary analysis of loss characteristics for personnel within the submarine service. A sample of 3607 submariners who entered Basic Enlisted Submarine School in FY81-82 was tracked for up to 14 quarters using the Enlisted Survival Tracking File (STF).

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This research was undertaken to understand more about each of the various groupings of individuals lost from the submarine service. The temporal distribution of losses may illuminate psychological and historical characteristics of submarine service personnel operations. Initial analyses classify individuals completing or failing to complete their tour of duty as indicated by Department of Defense loss codes. Later analyses rationally classify losses into broad groups of misconduct, psychological, physical, and performance loss categories.

Finally, groups identified by Department of Defense loss codes were empirically clustered on the basis of time to important career events (entry into Submarine School, completion of Submarine School, assignment to submarine, and qualification) and percent lost for each group at each career transition (graduation, submarine assignment, and qualification).

Three distinct loss periods are present in the sample examined. The first period (within one year after entry into the submarine service) reflects academic difficulties. The second period (the first to second year) represents behavioral difficulties during adaptation to the submarine environment. Finally, the third period of loss, and the most pronounced (approximately the third year), is characterized by misconduct offenses.

Several possible explanations for the loss characteristics are presented. In general, individuals likely to be successful in completing their term of enlistment have been delayed in their assignment to active submarine duty. This delay is most likely due to additional specialized training. Three avenues of investigation relating to voluntary turnover in other employee environments are discussed (Organizational Committment, Job Attachment, and Stress Responses). These constructs are related to specific areas for future research on involuntary attrition from the submarine service. It is suggested that a model for withdrawal from the submarine service be developed and psychological screening programs for identification of individuals likely to be lost prematurely from the submarine service be instituted.

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